

be enhanced with an introduction of such QA tool in the clinic.

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Normal tissue dose reduction by in-body electron modulation, using local magnetic field

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Purpose/Objective: Energy of gamma ray radiotherapy is transferred by electrons in both target tumors and surrounding normal tissues. If electrons, generated in body tissues, could be specifically removed in critical normal tissues, these normal tissues will be spared without compromising the target tumor dose. The purpose of this study was to present a new method of in-body electron modulation, using a magnetic field, to reduce dose of normal tissues near a target tumor.

Materials and Methods: Two tissue equivalent phantoms which composed with normal tissue area (NTA) and target tumor area (TTA) were developed; 1) single beam model (SBM) phantom to analyze a longitudinal percentage depth dose curve, and 2) multi-beam model (MBM) phantom to analyze a cross sectional dose of both NTA and TTA dose. Distance of a gap between NTA and TTA were 5mm. The phantoms were irradiated using 3x3cm sized field of 6MeV photon beam with or without 0.3T local magnetic field through beam path to remove forward electrons. Absorbed dose were measured in each NTA and TTA.

Results: With magnetic field applied, bending effect of the electron beam path was visualized in longitudinal film data. The percentage depth dose curve of SBM phantom showed about 40% dose reduction in NTA and almost no dose difference in TTA with magnetic field. Re-build up phenomenon were observed in the gap between NTA and TTA. In MBM phantom experiment, dose of the NTA were 300 cGy and 190 cGy, without and with magnetic field, respectively (36.7 % dose reduction). And dose of the TTA were 600 cGy and 580 cGy, without and with magnetic field, respectively (3.3% dose difference).

Conclusions: Applying local magnetic field could reduce dose of normal tissues near a target by removing forward electrons without compromising target dose in gamma ray radiotherapy. Further in vivo studies are needed to confirm biologic significance of this phantom experiment.

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Are daily dose recalculations really necessary in head and neck helical tomotherapy?

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Purpose/Objective: Head and neck cancer patients often undergo important soft tissue changes during radiotherapy. To assess the actual delivered dose recalculated on the daily IGRT images is often time consuming and mostly not routinely feasible. The aim of this study was to assess whether daily

dose recalculations are necessary and to develop a recommendation for daily practice.

Materials and Methods: Six head and neck cancer patients treated in our department with helical tomotherapy were analyzed for this work in progress. Total fraction number was 32 to 34 per patient. All patients underwent daily IGRT by MVCT at the Tomotherapy Unit. For each patient, we retrospectively performed daily dose recalculations on the MVCTs to assess the influence of soft tissue changes on dose distributions. We evaluated several summation doses: daily dose summations (DayDo), dose recalculations/summations every second day (2Do), once a week (1WeDo) and once every two weeks (2WeDo). For the days when the dose recalculation on the MVCT was not performed, the day(s) before were summed up. In order to avoid dose recalculation errors due to recalculation on MVCTs, we compared the summation doses with the doses recalculated on the first MVCT (MVCT1Do) (expected to be very similar to the planning CT) times the total number of fractions.

We analyzed the mean dose (Dmean), the maximum dose (Dmax), the Dmax in 1 cm³ (D1cc) and the minimum dose (Dmin). For the PTV: Dmax, Dmin and Dmean; for the spinal cord (SC): Dmax, D1cc, for the SC+5mm: Dmax, D1cc; for the parotid glands (PG): Dmean; for the mandible (Mnd): Dmean, Dmax.

Results: Overall, for all OAR the median changes as compared to MVCT1Do was 3.3Gy (range: +8Gy (for SC+5mm) to -8.73Gy (Mnd)). The median PTV Dmax change as compared to MVCT1Do was -0.71Gy (+0.13Gy to -3.01Gy), the Dmin +4.24Gy (+5.39Gy to -1.59Gy) and the Dmean change was -0.07 (0.09Gy to -0.26Gy). The differences between the scenarios (DayDo as compared to 2Do, 1WeDo and 2WeDo) were small and mostly not statistically significant. The only statistically significant differences between the scenarios were for the PTV Dmean and the SC Dmax and D1cc. The overall median differences in Gy (range) between the DayDo and the 2Do, 1WeDo and 2WeDo are presented in the table.

Structure	Analyzed dose	2Do	1WeDo	2WeDo
		(median differences in Gy to the daily dose recalculations/summations over the whole treatment course)		
PTV	Dmax	-0.04 (0.12 to -0.11)	0.03 (0.20 to -0.43)	-0.05 (0.23 to -0.38)
	Dmin	-0.06 (0.08 to -1.52)	-0.56 (0.32 to -3.37)	-0.14 (1.04 to -2.33)
	Dmean	-0.13 (0.04 to -0.98)	-0.33 (0.13 to -2.09)	-0.28 (0.09 to -1.00)
spinal cord	Dmax	-0.41 (0.12 to -2.29)	-0.62 (0.08 to -3.72)	-0.56 (0.49 to -2.29)
	D1cc	-0.25 (0.18 to -1.23)	-0.43 (-0.02 to -2.56)	-0.97 (0.26 to -3.72)
right parotid gland	Dmean	-0.02 (0.03 to -0.67)	-0.17 (0.03 to -1.49)	-0.34 (0.04 to -0.71)
left parotid gland	Dmean	0.05 (0.17 to -1.06)	0.11 (0.26 to -2.37)	0.03 (0.25 to -1.20)
mandible	Dmean	-0.04 (0.04 to -1.09)	-0.18 (0.08 to -2.43)	-0.15 (0.12 to -1.21)
	Dmax	-0.03 (0.10 to -0.97)	0.09 (0.22 to -2.17)	0.31 (0.40 to -1.07)

Conclusions: Significant changes can be observed during treatment. Daily dose recalculations remain a 'gold' standard. Nonetheless less time consuming scenarios can be used for some structures to assess the actual delivered doses during treatment with an implication on adaptive replanning.